

APPENDIX E

SDC Software Quality Management Plan

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1.0 INTRODUCTION

This document presents the SDC plan for controlling the performance of selected Software Engineering Environment (SEE) software engineering processes. This plan addresses how the SDC policy for Software Quality Management (SQM) will be implemented.

2.0 SQM PLAN GOALS

The SDC identified a primary goal of providing quality software products to EPA. SQM is a software engineering process that manages the quality of software products using quantitative measurements made during the product development process (as defined by Quantitative Process Management (QPM); refer to *SDC Quantitative Process Management Plan*). In order to manage quality it is necessary to define quality in a measurable ways.

The SDC product quality goal encompasses three distinct and competing goals of the MOSES contract. Specifically the quality goal, in order to be measured, must be decomposed into the following competing goals: the right product, delivered at the right time, and at the right cost.

Goal 1: Provide the right product. The technical quality of the software work product, defined by IEEE as the *utility* of the product, is one characteristic of the right product. This goals answers the following questions:

- C Is the product suitable for its intended use?
- C Is the product in compliance with requirements, specifications, standards, and fitness-for-use?

Goal 2: Deliver the product at the right time, i.e., on schedule. This answers the question: is the product delivered and available for use when it is required?

Goal 3: Complete the development of the product at the appropriate cost. This answers the question: is the product provided at a cost acceptable to the customer?

Individual Task Order Statements of Work (SOW) may identify additional quality goals. For example, EPA performance goals such as administrative burden reduction, may be specified as project performance goals, in terms of reduced reporting hours. When a project SOW identifies such additional quality goals, the strategy for achieving these goals will be addressed in the project plan, and the method for measuring characteristics of these goals will be defined in the project's SQM plan.

2.1 SQM Plan Overview

The SEE defines the SDC overall software engineering environment. The SEE defines many process from which the following processes were selected for SQM:

- Integration Testing.
- PA Testing.
- PA Review.
- Peer Review.
- Project Planning.
- Project Management and Tracking.

These processes were selected for SQM because of their significant impact on product quality. The first four processes listed above, if under QPM control, are especially suited to measuring defect density, i.e., the number of defects per unit of effort expended, within a software work product (SWP) and are thus useful, in SQM, for calculating a measure of the technical quality of the SWP.

The other two processes were selected for their usefulness in measuring other quality goals. Project planning and project management are a useful processes for measuring quality as it relates to schedule and cost.

This plan presents a process whereby SDC SEE processes are used to collect measurement data about the quality of the software products being produced. The SEE processes selected to support SQM are a subset of the processes selected for control under QPM. Test and inspection processes are useful for deriving a measure of Goal 1, the technical quality of the software work product. SQM also uses project planning and project management as useful processes for measuring Goals 2 and 3 that relate to schedule and cost.

2.2 SQM Plan Implementation

SQM is performed at the project level and the SDC organization level. Project-level activities and organization-level activities are summarized in the following paragraphs. Exhibit E-1 presents a graphical representation of the SQM process.

At the project level each project coordinates with management and customers to prioritize product quality goals and to set the quantitative target value for specific products at specific points in the development process. Customer involvement in identification of quality goals is an important step in SQM plan preparation. Goals should be established for products at each stage of the SDLC. The specific measuring process used will depend upon the scope of the project plan tasks and the other project-unique circumstances.

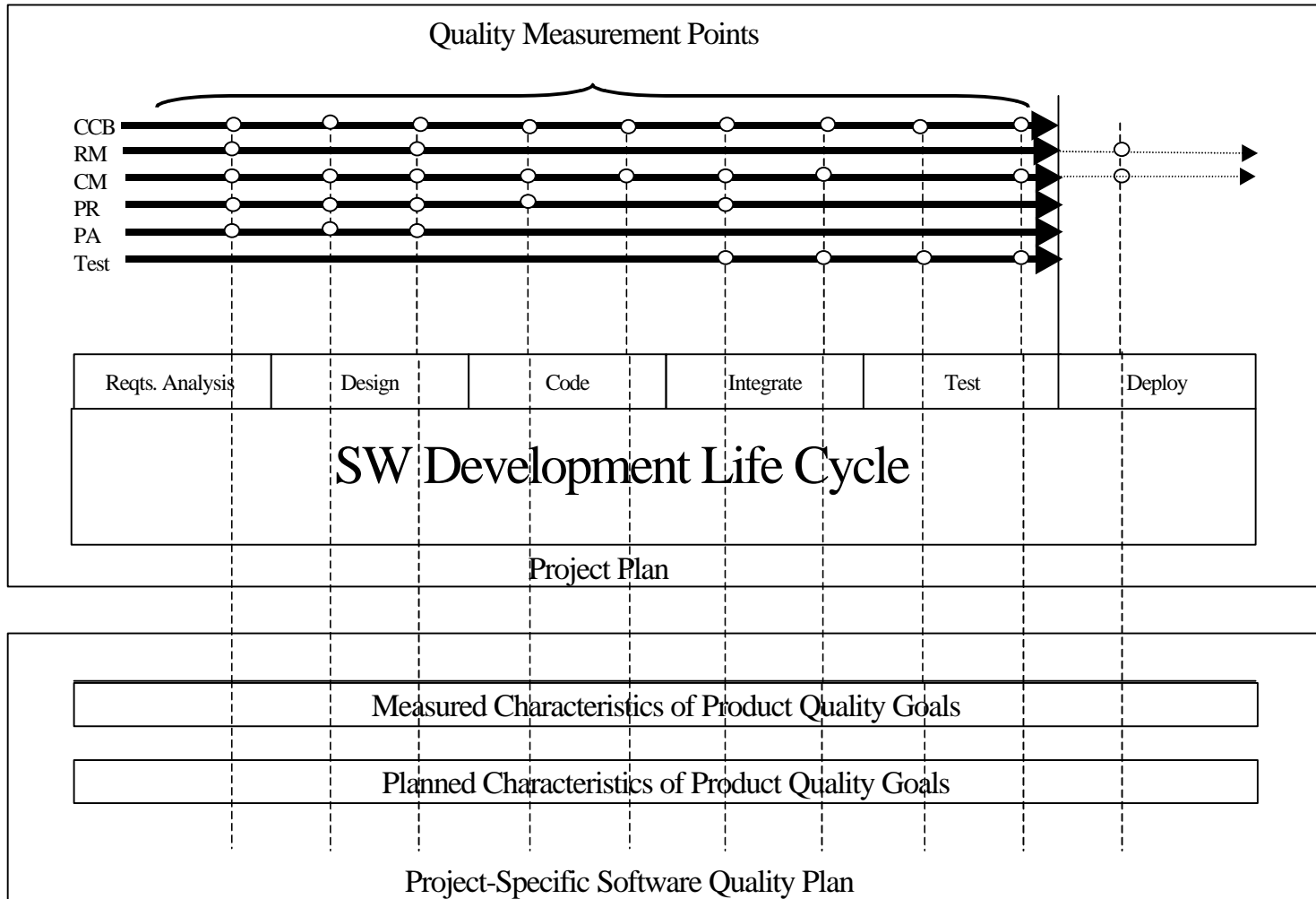


Exhibit E-1. SQM Process Overview

SQM occurs at both project -level and organization-level activities. Project-specific quality goals are documented in a project SQM Plan. The plan will be prepared within the first thirty days after EPA approves a new or revised project plan, unless a viable SQM plan is currently in effect.

The project-specific SQM plan is prepared using a template provided by the DMMG. The SQM plan is submitted for review and approval by SDC management. Copies of approved

SQM plans will be retained by the project team and by the DMMG.

As the project proceeds, additional insight into the customers expectations for quality may initiate needed revision of the SQM. The SQM plan should be maintained to reflect current quality goals

A project-level SQM plan template, based on *SDC Guideline: Project and Organization Metrics*, is provided by the DMMG. Any SDC controlled processes that do not apply to current tasks may, if approved, be removed from the project's SQM plan by following *Tailoring SDC Policies, Guidelines, Procedures and Standards to Project Specific Requirements*.

After the project-level SQM plan is approved, a project records planned quality goals, as required by their tailored plans, in the SDC Metrics Tracking System (METRS). Periodically (normally every four weeks) produce process control charts that show a project's Measure of Process Effectiveness (MPE) and Measure of Process Utilization (MPU) (defined in the *SDC Quantitative Process Management Plan*, Section 2.2.1.1). These values multiplied together to yield a measure of technical quality (MTQ) that is compared to the project's and the SDC's technical quality goals. If a project's MTQ is within the range established by the goals, no management action is required. However, if the project's MTQ significantly deviates from the planned quality goals, the cause is identified to determine if corrective action is needed. If determined, either by the Technical Project Leader (TPL) or SDC senior management, that corrective action is needed, the implementation and subsequent effects of the action will be reviewed during the monthly project reviews.

At the organization level, the SEE committee will establish baseline values of SDC technical quality goals. The SEE committee evaluates, on a regular basis, the need to revise these goals based on project performance throughout the SDC.

The ongoing nature of the SQM process is described in *SDC Procedure: Performing Software Quality Management*.

A detailed explanation of the analysis portion of SQM can be found in Appendix A of the *SDC Guideline: Project and Organizational Metrics*, The Derivation of QPM and SQM Analyses for the SDC.

2.2.1 Quality Measurement

Throughout the development life cycle, software products will be measured in the processes, tasks, and development stages specified in the plan. If the product meets the targeted quality goal, the TPL can be assured that the software engineering processes performed by the project team are producing products that meet SDC quality standards. If the products do not meet targeted quality goals, the TPL knows that the software engineering processes of the project team need management attention.

At the organizational level, the SDC aggregates the results of product quality measurements made by other SDC projects. These measurements are analyzed to set benchmark values to guide SQM planning at the project level.

2.2.2 Measuring Reliability – Latent Defects

Problems that a user encounters after a software product has been deployed are a measure of the technical quality of the software product. These problems may be attributable to a deficiency in the process use to produce the product, or they may be attributable to other causes. In either case, the customer's expectations for the product performance are not satisfied by the product. Reports of user problems are documented through change requests, support hotline calls, customer surveys, and other means. Each problem report will be analyzed to determine if the problem is a defect in the software product. Identification and analysis of latent product defects is valuable information for measuring the SDC's software engineering process performance. Tracking and analyzing latent defects assists planning for process improvement. Latent defects are an indication of the reliability of the software product. Analysis of latent defect counts as a function of time after the product release date can be useful for quantifying reliability goals and for measuring improvements in reliability. Latent defects are measured in the Product Engineering KPA and reported via SQM.

2.3 SQM Metrics

The purpose of SQM is to identify characteristics of quality for software products and to manage those characteristics through quantitative measurements. Examples of these characteristics include functionality, reliability, maintainability, and usability. Each of these examples is a component of the technical quality goal. Metrics that are useful for measuring these quality characteristics are obtained from data gathered during the performance of SDC software engineering processes documented in the SEE

For those processes under QPM control, the measure of technical quality (MTQ) is defined as $MPE \times MPU$ (available via QPM), which results in the defect density of the software work product. The actual MTQ achieved is compared to the planned MTQ.

For processes such as project planning and project management, statistical means and variances are calculated from actual versus planned data.

3.0 RESPONSIBILITIES

Responsibilities for various aspects of the SQM process are identified below.

3.1 Project Team Responsibilities

Project Teams are responsible for performing the following SQM activities:

- Prepare a project-specific SQM Plan. Project-specific quality goals are documented in a project SQM Plan. The plan will be prepared within the first thirty days after EPA approves a new initial or revised project plan, unless a viable SQM plan is currently in effect.
- Collect and submit monthly process metrics as defined in the *SDC Guideline: Project and Organization Metrics*.
- Analyze SQM measures of technical quality to determine the need for corrective action to bring project-level practices into alignment with SDC Quality goals.
- Participate in monthly project reviews and discuss corrective actions with SDC senior management.

3.2 DMMG

The DMMG is responsible for performing the following SQM activities:

- Establish and maintain SQM procedures, tools, templates and METRS.
- Review and approve project-level SQM plans.
- Produce Monthly project and organization level MTQs.
- Conduct SEE Meeting reviews of Organization-Level SQM measurements to determine the need to revise established SDC baseline goals.
- Maintain historical archive of MTQs.

3.3 SDC Senior Management:

SDC Senior managers are responsible for performing the following SQM activities:

- Ensure projects compliance with SDC SQM process.
- Review project-specific SQM Plans.
- Participate in monthly project reviews and discuss corrective actions with SDC senior management.
- Participate in SEE Meeting reviews of organization-level MTQs to determine the need to establish or revise SDC baseline quality goals.

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